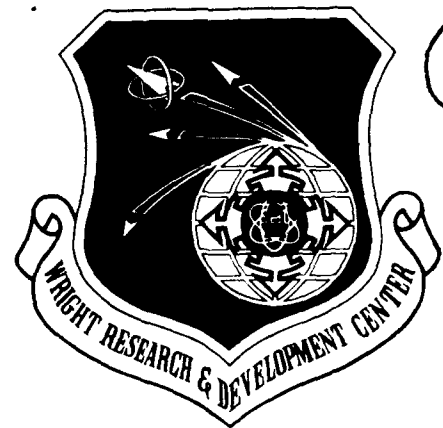


WRDC-TR-90-8007
Volume V
Part 17

AD-A250 456



INTEGRATED INFORMATION SUPPORT SYSTEM (IISS)
Volume V - Common Data Model Subsystem
Part 17 - Neutral Data Manipulation Language (NDML) Precompiler
Transform Internal Schema Access Path to Generic DML Product
Specification

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Control Data Corporation
Integration Technology Services
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September 1990

Final Report for Period 1 April 1987 - 31 December 1990

Approved for Public Release; Distribution is Unlimited

92-13521

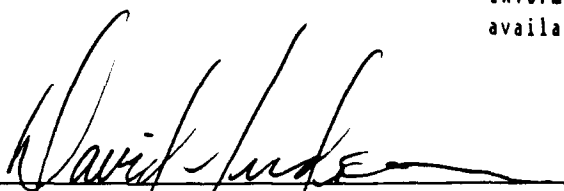
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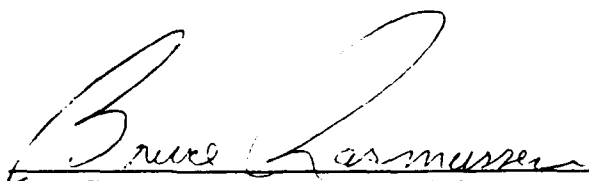
This technical report has been reviewed and is approved for publication.

This report is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations


DAVID L. JUDSON, Project Manager
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25 July 91
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FOR THE COMMANDER:


BRUCE A. RASMUSSEN, Chief
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25 July 91
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SECURITY CLASSIFICATION OF THIS PAGE

| REPORT DOCUMENTATION PAGE | | | | |
|--|-------|--|---|---|
| 1a. REPORT SECURITY CLASSIFICATION Unclassified | | 1b. RESTRICTIVE MARKINGS | | |
| 2a. SECURITY CLASSIFICATION AUTHORITY | | 3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release; Distribution is Unlimited. | | |
| 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE | | | | |
| 4. PERFORMING ORGANIZATION REPORT NUMBER(S) PS 620341252 | | 5. MONITORING ORGANIZATION REPORT NUMBER(S) WRDC-TR-90-8007 Vol. V, Part 17 | | |
| 6a. NAME OF PERFORMING ORGANIZATION Control Data Corporation; Integration Technology Services | | 6b. OFFICE SYMBOL (if applicable) WRDC/MTI | | 7a. NAME OF MONITORING ORGANIZATION WRDC/MTI |
| 6c. ADDRESS (City, State, and ZIP Code) 2970 Presidential Drive Fairborn, OH 45324-6209 | | 7b. ADDRESS (City, State, and ZIP Code) WPAFB, OH 45433-6533 | | |
| 8a. NAME OF FUNDING/SPONSORING ORGANIZATION Wright Research and Development Center, Air Force Systems Command, USAF | | 8b. OFFICE SYMBOL (if applicable) WRDC/MTI | | 9. PROCUREMENT INSTRUMENT IDENTIFICATION NUM. F33600-87-C-0464 |
| 8c. ADDRESS (City, State, and ZIP Code) Wright-Patterson AFB, Ohio 45433-6533 | | 10. SOURCE OF FUNDING NOS. | | |
| 11. TITLE (Include Security Classification) See block 19 | | PROGRAM ELEMENT NO. 78011F | PROJECT NO. 595600 | TASK NO. F95600 WORK UNIT NO. 20950607 |
| 12. PERSONAL AUTHOR(S) Control Data Corporation: Apicella, M. L., Slaton, J., Levi, B. | | | | |
| 13a. TYPE OF REPORT Final Report | | 13b. TIME COVERED 4/1/87-12/30/90 | | 14. DATE OF REPORT (Yr., Mo., Day) 1990 September 30 |
| 15. PAGE COUNT 18 | | | | |
| 16. SUPPLEMENTARY NOTATION WRDC/MTI Project Priority 6203 | | | | |
| 17. COSATI CODES | | | 18. SUBJECT TERMS (Continue on reverse if necessary and identify block no.) | |
| FIELD | GROUP | SUB GR. | | |
| 1308 | 0905 | | | |
| | | | | |
| 19. ABSTRACT (Continue on reverse if necessary and identify block number) This document establishes the design of Function PRE7, "Change NDML to DML", one of the major functions of the Configuration Item "Precompiler" to be built and formally accepted by the ICAM program office. BLOCK 11: INTEGRATED INFORMATION SUPPORT SYSTEM Vol V - Common Data Model Subsystem Part 17 - Neutral Data Manipulation Language (NDML) Precompiler Transform Internal Schema Access Path to Generic DML Product Specification | | | | |
| 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED x SAME AS RPT. DTIC USERS | | | 21. ABSTRACT SECURITY CLASSIFICATION Unclassified | |
| 22a. NAME OF RESPONSIBLE INDIVIDUAL David L. Judson | | | 22b. TELEPHONE NO. (Include Area Code) (513) 255-7371 | 22c. OFFICE SYMBOL WRDC/MTI |

FOREWORD

This technical report covers work performed under Air Force Contract F33600-87-C-0464, DAPro Project. This contract is sponsored by the Manufacturing Technology Directorate, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Bruce A. Rasmussen, Branch Chief, Integration Technology Division, Manufacturing Technology Directorate, through Mr. David L. Judson, Project Manager. The Prime Contractor was Integration Technology Services, Software Programs Division, of the Control Data Corporation, Dayton, Ohio, under the direction of Mr. W. A. Osborne. The DAPro Project Manager for Control Data Corporation was Mr. Jimmy P. Maxwell.

The DAPro project was created to continue the development, test, and demonstration of the Integrated Information Support System (IISS). The IISS technology work comprises enhancements to IISS software and the establishment and operation of IISS test bed hardware and communications for developers and users.

The following list names the Control Data Corporation subcontractors and their contributing activities:

SUBCONTRACTOR

ROLE

| | |
|--|--|
| Control Data Corporation | Responsible for the overall Common Data Model design development and implementation, IISS integration and test, and technology transfer of IISS. |
| D. Appleton Company | Responsible for providing software information services for the Common Data Model and IDEF1X integration methodology. |
| ONTEK | Responsible for defining and testing a representative integrated system base in Artificial Intelligence techniques to establish fitness for use. |
| Simpact Corporation | Responsible for Communication development. |
| Structural Dynamics Research Corporation | Responsible for User Interfaces, Virtual Terminal Interface, and Network Transaction Manager design, development, implementation, and support. |
| Arizona State University | Responsible for test bed operations and support. |

TABLE OF CONTENTS

| | | <u>Page</u> |
|-------------|---|-------------|
| SECTION 1.0 | SCOPE | 1-1 |
| 1.1 | Identification | 1-1 |
| 1.2 | Functional Summary | 1-1 |
| SECTION 2.0 | DOCUMENTS | 2-1 |
| 2.1 | Reference Documents | 2-1 |
| 2.2 | Terms and Abbreviations | 2-1 |
| SECTION 3.0 | REQUIREMENTS | 3-1 |
| 3.1 | Structural Description | 3-1 |
| 3.2 | Functional Flow | 3-1 |
| 3.3 | Interfaces | 3-1 |
| 3.3.1 | Inputs/Outputs | 3-1 |
| 3.4 | Program Interrupts | 3-2 |
| 3.5 | Timing and Sequencing Description | 3-2 |
| 3.6 | Special Control Features | 3-2 |
| 3.7 | Storage Allocation | 3-2 |
| 3.7.1 | Database Definition | 3-2 |
| 3.7.1.1 | File Description | 3-2 |
| 3.7.1.2 | Table Description | 3-2 |
| 3.7.1.3 | Item Description | 3-2 |
| 3.8 | Object Code Creation | 3-2 |
| 3.9 | Adaptation Data | 3-3 |
| 3.10 | Detail Design Description | 3-3 |
| 3.10.1 | Where Include File Used List | 3-3 |
| 3.10.2 | Where External Routine Used List ... | 3-4 |
| 3.10.3 | Main Program Parts List | 3-4 |
| 3.10.4 | Module Documentation | 3-4 |
| 3.10.5 | Include File Descriptions | 3-7 |
| 3.10.6 | Hierarchy Chart | 3-9 |
| 3.11 | Program Listings Comments | 3-9 |
| SECTION 4.0 | QUALITY ASSURANCE PROVISIONS | 4-1 |
| 4.1 | Introduction and Definitions | 4-1 |
| 4.2 | Computer Programming Test and Evaluation | 4-1 |

SECTION 2

DOCUMENTS

2.1 Reference Documents

1. ICAM Documentation Standards: IDS15012000A, 28 December 1981.
2. D. Appleton Co., CDM Administrators Manual: UM620141000, March 1984.
3. D. Appleton Co., CDM1-IDEF, Model of the Common Data Model: CCS620141000, 15 May 1985.
4. D. Appleton Co., Computer Program Development Specification (DS) for ICAM Integrated Support System (IISS) Configuration Item: NDML Precompiler: DS620141200, October, 1984.
5. D. Appleton Co., Embedded NDML Programmer's Reference Manual: PRM620141200, March, 1985.
6. Softech, Inc., NTM Programmer's Guide: UM620140001, July, 1984.
7. Control Data Corporation, Computer Development Specification (DS) for ICAM Integrated Support System (IISS) Configuration Item: NDML Command Processor: DS620141100, June 1985.

2.2 Terms and Abbreviations

Attribute Use Class: (AUC)

Conceptual Schema: (CS)

Common Data Model Processor: (CDMP)

Common Data Model: (CDM) Describes common data application process formats, form definitions, etc, of the IISS and includes conceptual schema, external, internal schemas, and schema transformation operators.

Data Field: (DF) An element of data in the external schema. It is by this name that an NDML programmer reference data.

Database Management System: (DBMS)

Distributed Request Supervisor: (DRS) This IISS CDM subsystem configuration item controls the execution of distributed NDML queries and non distributed updates.

Domain: A logical definition of legal attribute class values.

Domain Constraint: Predicate that applies to a single domain.

External Schema: (ES)

Forms: Structured views which may be imposed on windows or other forms. A form is composed of fields where each field is a form, item, or window.

Forms Processor: (FP) A set of callable execution time routines available to an application program for form processing.

Internal Schema: (IS)

Integrated Information Support System: (IISS) A test computing environment used to investigate, demonstrate and test the concepts of information management and information integration in the context of Aerospace Manufacturing. The IISS addresses the problems of integration of data resident on heterogeneous databases supported by heterogeneous computers interconnected via a local Area Network.

Mapping: The correspondence of independent objects in two schemas: ES to CS or CS to IS.

Network Transaction Manager: (NTM) Performs the coordination, communication and housekeeping functions required to integrate the application processes and system services resident on the various hosts into a cohesive system.

Neutral Data Manipulation Language: (NDML) A language developed by the IISS project to provide uniform access to common data, regardless of database manager or distribution criteria. It provides distributed retrieved and single node updates.

ORACLE: Relational DBMS based on the SQL (Structured Query Language, a product of ORACLE Corp, Menlo Park, CA). The CDM is an ORACLE database.

Parcel: A sequential file containing sections source code of the input application program.

Request Processor: (RP) A COBOL program that will satisfy a retrieval or update NDML subtransaction against a particular Database Management System.

User Interface: (UI) Controls the user's terminal and interfaces with the rest of the system.

Virtual Terminal Interface: (VTI) Performs the interfacing between different terminals and the UI. This is done by defining a specific set of terminal features and protocols which must be supported by UI software which constitutes the Virtual Terminal Definition. Specific terminals are then mapped against the Virtual Terminal software by specific software modules written for each type of real terminal supported.

SECTION 3

REQUIREMENTS

3.1 Structural Description

Not applicable to this CPCI.

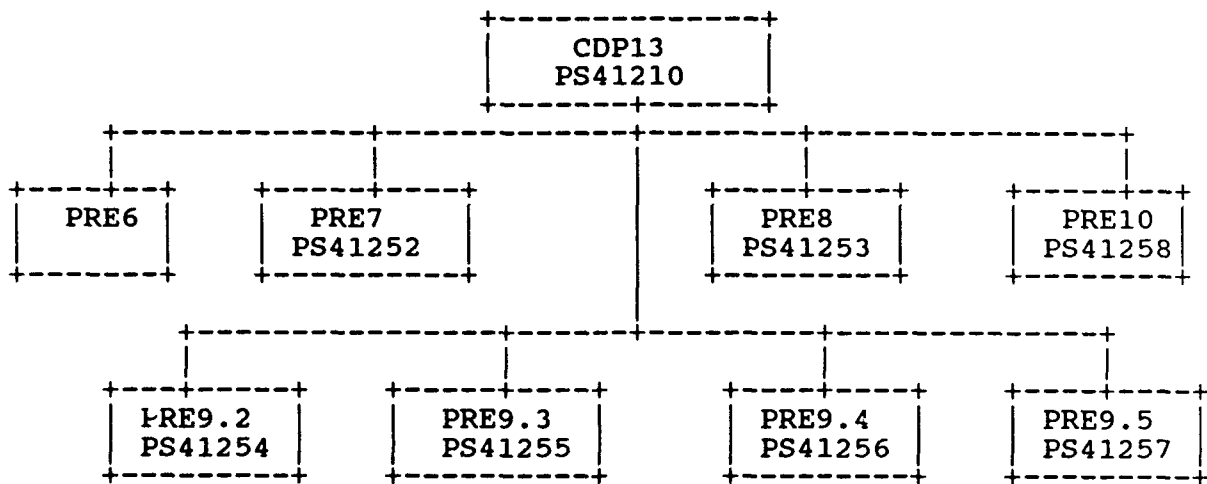
3.2 Functional Flow

This CPCI implemented the logic defined in the Development Specification for this CPCI. Details of inputs/outputs and relationships between modules are found in Section 3.10.

This CPCI has been designated to operate in a batch or interactive mode. It must operate in the system environment established for IISS; that is, the Network Transaction Manager. It currently can only be executed on the DEC VAX due to the dependence on the VAX sort although this can be changed for execution on the IBM.

3.3 Interfaces

The following diagram depicts the interface of PRE7 with other CPCI's in the system.



3.3.1 Inputs/Outputs

The following table depicts the inputs and outputs of this CPCI. A detailed description for each item can be found in the DS for this CPCI.

FUNCTION: PRE7

INPUT

OUTPUT

Error file name
Access Path specification code table
Record Key table

Error Status code
Generic CODASYL table

3.4 Program Interrupts

Not applicable to the CPCI.

3.5 Timing and Sequencing Description

This CPCI is activated for each CODASYL access path specification constructed by PRE6. The timing and sequence of the call to this CPCI is determined by the support routine CDP13.

3.6 Special Control Features

Not applicable to this CPCI.

3.7 Storage Allocation

3.7.1 Database Definition

The database used by this CPCI is the Common Data Model (CDM) database. The model is defined by the CDM1, the IDEF-1 model of the CDM, Reference Document Number 3.

3.7.1.1 File Description

No permanent files have been defined for this CPCI. It may use temporary scratch files for such things as input and results.

3.7.1.2 Table Description

All tables used by this CPCI have been defined by the Development Specification for this CPCI.

3.7.1.3 Item Description

Not applicable to this CPCI.

3.8 Object Code Creation

The object code for this CPCI will be created by the system integration team using defined IISS Software Configuration Management procedures. This CPCI will use the COBOL language compiler.

3.9 Adaptation Data

This CPCI has been coded using ANSI COBOL language. The intent was to provide a transportable system. Any system environment supporting these languages, a virtual memory management schema, the COMM and NTM subsystems of IISS and the ORACLE Database Management System should be able to support this CPCI. Every possible attempt has been made to localize and identify any machine or environment dependent modules throughout the original design of the IISS and application of Configuration Management Procedures.

3.10 Detail Design Description

The following sections have been computer generated for this CPCI.

3.10.1 Where Include File Used List

The following lists each include file in the documentation group and all the modules documented in this specification which include them. The purpose of each module is listed as well.

DOCGROUP PS41252 Where-include-file-used List

| Include File ----- | Module Name ----- |
|--------------------------|-------------------------|
| ERRCDM | CDPRE7 |
| ERRFS | CDPRE7 |
| INSTTBL | CDPRE7 |
| APAT | CDPRE7 |
| APRK | CDPRE7 |
| APGC | CDPRE7 |
| ERRPRO | CDPRE7 |

3.10.2 Where External Routine Used List

The following lists each external function or routine in the documentation group and all the documented modules which call it. The purpose of each module is listed as well.

DOCGROUP PS41252 Where-external-routine-used List

| System Module ----- | Module Name ----- |
|---------------------------|-------------------------|
| RPTERR | CDPRE7 |
| ERRPRO | CDPRE7 |

3.10.3 Main Program Parts List

The following lists each Main Program in the documentation group and all the modules which are called either by that module itself or by any of the documented modules which it calls. It is possible for a non-main module to be listed more than once if it is called by multiple modules. The called modules, in this case known as program parts, are marked as to whether they are documented here. If so, the phrase "well-defined module" appears by the module name, if not it is an "external routine". The Purpose of the Main Program module is listed as well.

DOCGROUP PS41252 Main Program Parts List

| Main Pgm Name ----- | Module Name ----- | Module Type ----- |
|---------------------------|-------------------------|-------------------------|
| CDPRE7 | | |
| | RPTERR | External routine |
| | ERRPRO | External routine |

3.10.4 Module Documentation

The following documentation describes information which is specific to each individual module in the documentation group being documented in this specification. It provides a compact way of getting information that would be otherwise buried within each module's source code.

The specific items in this module documentation have the following meanings:

| | |
|----------------------|--|
| NAME: | Name of program Module. |
| PURPOSE: | Purpose of Module as detailed in the source code. |
| LANGUAGE: | Programming language source code is written in. The choices are: VAX-11 FORTRAN C (I/S-1 Workbench 'C') VAX-11 COBOL |
| MODULE TYPE: | Whether a Program, Subroutine, or Function. |
| SOURCE FILE: | Name of Source File from file specification. |
| SOURCE FILE TYPE: | Source File Extension from file specification. |
| HOST: | Whether this is a host-dependent routine (VAX or IBM) or blank if host-independent. |
| SUBSYSTEM: | IISS sub-system this file resides in. |
| SUBDIRECTORY: | Sub-directory of that subsystem in which this file resides. |
| DOCUMENTATION GROUP: | Name of documentation group of which this source file is a member. |
| DESCRIPTION: | A description of the module as obtained from the source code. |
| ARGUMENTS: | The arguments with which this routine is called if it is a Subroutine or a Function. |
| INCLUDE FILES: | A list of all the files that are included into this module as well as their purposes. |
| ROUTINES CALLED: | Subroutines or Functions, either documented or external, called by this module, if any. |
| CALLED DIRECTLY BY: | The documented routines which call this module, if any. |

USED IN MAIN PROGRAM(S): The documented Main Programs which contain this module in their parts list according to the list in section 3.10.3.

The Module Documentation is arranged alphabetically according to Module Name.

DOCGROUP PS41252 Module Documentation

NAME: CDPRE7
PURPOSE: TRANSFORM AN IS ACCESS PATH TO GENERIC CODASYL
LANGUAGE: VAX-11 COBOL
SOURCE FILE: CDPRE7
SOURCE FILE TYPE: COB
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

DESCRIPTION:

```

- TRANSFORM AN ACCESS PATH TO GENERIC CODASYL
SPR 433- SM2 SHOULD GENERATE IRN, NOT IRF
SPR 731- RIJ, SPC mnemonics added for record outer join

```

ARGUMENTS:

```
FCB-E                                DSPLY[S9(9)]
ACCESS-PATHS                         RECRD
RECORD-KEY-TABLE                     RECRD
GC-TABLE                             RECRD
RET-STATUS                           DSPLY[X(5)]
```

INCLUDE FILES:

ERRCDM
ERRFS
INSTTBL
APAT
APRK
APGC
ERRPRO

ROUTINES CALLED:

RPTERR
ERRPRO

3.10.5 Include File Descriptions

The following list contains a purpose and description of each include file in the documentation group as specified in the source code. The language it is written in is also given.

DOCGROUP PS41252 Include File Description

FILE NAME: APAT
PURPOSE: ACCESS PATH TABLE
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS THE ACCESS PATH FOR ONE SUBTRANSACTION
FOR A NDML REQUEST.

DOCGROUP PS41252 Include File Description

FILE NAME: APGC
PURPOSE: GENERIC CODASYL COMMAND TABLE
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

HOLDS THE GENERIC CODASYL DML COMMANDS FOR AN
ACCESS PATH OF AN NDML REQUEST

DOCGROUP PS41252 Include File Description

FILE NAME: APRK
PURPOSE: TABLE OF RECORD KEYS FOR CODASYL ACCESS PATHS
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS INFORMATION FOR THE KEYS OF
RECORDS CONTAINED IN THE CURRENT ACCESS
PATH

DOCGROUP PS41252 Include File Description

FILE NAME: ERRCDM
PURPOSE: IISS ERROR STATUS CODES FOR CDMP MODULES
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

CONTAINS ALL ERROR CODES USED BY CDMP *
MODULES FOR ERROR HANDLING *

DOCGROUP PS41252 Include File Description

FILE NAME: ERRFS
PURPOSE: ERRFS.INC - FILE I/O PRIMITIVES (FILE SERVICES)
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

IISS ERROR CODES

THIS FILE DEFINES THE FS STATUS
CODES IN COBOL FORMAT

DOCGROUP PS41252 Include File Description

FILE NAME: ERRPRO
PURPOSE: PROCESS ERROR INCLUDE FILE
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

DOCGROUP PS41252 Include File Description

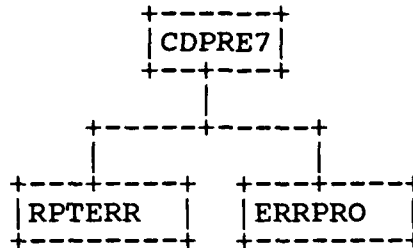
FILE NAME: INSTTBL
PURPOSE: TABLE CONTAINING ALL GENERIC CODASYL COMMANDS
LANGUAGE: VAX-11 COBOL

DESCRIPTION:

DECODE FOR THE GENERIC CODASYL COMMANDS

3.10.6 Hierarchy Chart

1



CDPRE7.....1
ERRPRO
RPTERR

3.11 Program Listings Comments

This information is contained in the Module Descriptions in section 3.10.

SECTION 4

QUALITY ASSURANCE PROVISIONS

4.1 Introduction and Definitions

"Testing" is a systematic process that may be preplanned and explicitly stated. Test techniques and procedures may be defined in advance, and a sequence of test steps may be specified. "Debugging" is the process of isolation and correction of the cause of an error.

"Antibugging" is defined as the philosophy of writing programs in such a way as to make bugs less likely to occur and when they do occur, to make them more noticeable to the programmer and the user. In other words, as much error checking as is practical and possible in each routine should be performed.

4.2 Computer Programming Test and Evaluation

The quality assurance provisions for test consists of the normal testing techniques that are accomplished during the construction process. They consist of design and code walk-throughs, unit testing, and integration testing. These tests are performed by the design team. Structured design, design walk-through and the incorporation of "antibugging" facilitate this testing by exposing and addressing problem areas before they become coded "bugs."